THE SPACE SHUTTLE: INVESTIGATION OF EARTH RESOURCES BY MANNED OBSERVATIONS

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Investigation of earth resources from outer space provides for man a unique opportunity to view from a distance the composition and content of the planet upon which he resides.

Presently, unmanned orbiting satellites are gathering important information about earth resources and relying this information back to earth stations. When man establishes laboratories[1] in earth orbit, the potential of significant benefits from such investigations will materially increase.

After completion of the Skylab series, it is anticipated that a unique craft, capable of flight into and from earth orbit, will provide continuous transport of men and supplies into earth orbit. This vehicle is referred to as "The Space Shuttle". It is configured as an aircraft type orbiter, mated to a launch booster. Present design for the orbiter provides for a delta-winged craft about the size of a DC-9,[2] capable of 100-150 flights in space.[3] The solid fueled booster will be jettisoned over water and recovered for reuse; and the orbiter, after completing its mission, would return through earth's atmosphere by aerodynamic flight and conventional landing. The United States has apparently committed itself to the construction of this dual functioning system.

Success of the shuttle will provide less costly and more frequent orbiting space stations. Based upon existing designs, the orbiter may carry as many as twelve persons on a flight.[4]

Since the normal crew complement would be four, space is available for up to eight scientific investigators. One of the shuttle's greatest assets is that passengers need not be especially trained for space flight;[5] therefore, the scope of earth resources investigations may be far more extensive than contemplated in early missions. Barring unforseen restrictions in programming, an operational craft may be flyable toward the close of this decade.

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1Project Skylab is scheduled for 1973 utilizing rotational three men crews to be stationed in orbit for one to two months. For comprehensive discussion of the mission objectives, see *National Aeronautics and Space Administration, Sky-lab Program Description* (1971).

2120 feet long, wing span 75 feet,with a pay load of 65,000 pounds out to 100 mile earth orbit.

3*Aviation Week,* March 20, 1972, at 14, 15.

4Id. at 15.

5*Air Force Magazine,* March 1972, at 21, 24. See also Ulsamer, The Shuttle: U.S.'s Airline Into Space, *Air Force Magazine,* September 1971, at 53. See also *National Aeronautics and Space Administration, 1 Earth Orbital Research and Applications Investigations* 3-1, 3-11 (1971).

Although inauguration of space shuttle operations will provide routine transfer of personnel from earth's surface to orbiting stations and facilities, manned outer space investigation will have already begun under project "Skylab". Some earth resources applications are included in the Skylab program;[6] however, present planning emphasizes celestial investigations, bio-medical research and zero-gravity experiments. A vehicle such as the shuttle will possess the capability of rendezvous not only with manned stations, but also with unmanned observatories. Conceivably, service, repair and satellite placement missions as well as retrieval of satellites and data would augment manned transportation.

The Shuttle, as presently conceived, is to be the workhorse of near earth operations. It will transport passengers, supplies and space station modules through the atmosphere into orbit, and later return them to earth within its cargo compartment.

The shuttle system's will be launching ballistically similar to the Titan III method. It will enter and function in orbit much the same as other manned systems; however, its ability to maneuver in orbit, to carry large payloads, to re-enter the atmosphere and to fly aero-dynamically, distinguish it from all prior outer space vehicles.[7] Since flight after re-entry is a significant departure from present procedures, does the orbiter remain a space object or does it become an aircraft subject to all the rules and regulations of flight in antional or international airspace? Is it, therefore, a legal chameleon that assimilates with the environment in which it functions? If so, what then is the responsibility of the launching state for damage resulting to foreign aircraft while the shuttle orbiter is in aero-dynamic flight?[8]

In brief, the shuttle will offer a new dimension to man's occupation of the near-space environment and will provide expanded observation of conditions existing on earth, in earth orbit and in the solar system. The orbiter itself may be a useful short term platform for manned investigation of earth resources;[9] and it will also provide access to manned and unmanned orbiting stations so that sustained research of earth's environment may be conducted.[10] Without the means of frequent and relatively low cost transport of personnel, equipment and supplies, man's existence in earth orbit is severely limited.

The knowledge gained and the service provided from earth orbit activities should provide an effective cost-result ratio acceptable to the nation's economy. The direct benefit derived from locating fresh water resources, mineral deposits, and sea food

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[6]Sky-Lab Program Description, supra note 1, at 45.

[7]The orbiter is expected to be able to deviate up to 1000 miles from a straight in flight path. Ulsamer, *Air Force Magazine*, March 1972, at 24.

[8]See Article II, of the Draft Convention on International Liability for Damage caused by Space Objects, 8 *U. N. Monthly Chronicle*, July 1971, at 19-25. This provision appears to make liability absolute for damage caused by a space object to aircraft in flight.

[9]See *Earth Orbital Research*, supra note 5, at 3-11.

[10]Id. at 3-12.

sources, as well as effective weather reporting and pollution control, will more than offset the extensive costs. True, unmanned satellites can do the reporting for less initial expenditures, but man's ability to interpret, service, repair and replace the equipment as required should result in long term cost reductions.[11]

Due to the unusual versatility of the Space Shuttle orbiter, several interesting legal questions arise. For example:

1. If the space shuttle assumes the posture of an aircraft, does it not legally become an aircraft for that portion of flight that is aero-dynamic?

2. May the shuttle orbiter be utilized to intentionally disable or destroy an objectionable unmanned earth resource satellite owned and operated by another state?

3. May the orbiter remove from orbit, without consent, derelict earth resources satellites owned by another state?

4. May personnel of the shuttle orbiter make unannounced inspections of manned observatories under the control of another state?

5. Will manned investigations of earth resources be deemed clandestine observations if they include information of strategic significance? (Photographs of military installations, mapping, etc.)

6. What measure of liability is applicable if accidental damage occurs to an earth resource satellite as the result of shuttle orbiter operation?

7. What measure of liability is applicable if the shuttle accidentally collides with an aircraft during the orbiter's aero-dynamic flight?

8. Should the space shuttle system be international or internationally controlled?

9. What rules of operation should govern a vehicle that is equally maneuverable in outer space and in airspace?

All the questions contemplated may not be answerable under the present state of development of outer space rules and may have to await the adoption of enlightened and more extensive international agreements before they are resolved.[12] One may, however,

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[11]For a discussion of the role of man in earth observations from outer space, see *National Aeronautics and Space Administration, 4 Earth Orbital Research and Applications*, 1-65, 1-68 (1971).

[12]Reference is made here to the consideration of an independent agency to oversee outer space affairs. See Tamm, Should an International Outer Space Agency be Established? *Proceedings of the XIII Colloquium on the Law of Outer Space 53* (1971).

ponder these questions and speculate upon appropriate solutions in the light of existing treaties and principles.

THE SHUTTLE AS A SPACE OBJECT

The shuttle vehicle, as presently conceived, is to be launched from facilities located on land, with a flight path over open water. The configuration will consist of a flight orbiter boosted into space by a solid fueled booster which is to be jettisoned over international waters and retrieved. In this context, the vehicle would conform to the definition of "space object" as set forth in Article I(d) of the proposed Liability Convention.[13] As the shuttle progresses into earth orbit, its character as a space object remains unchanged, and throughout its flight in orbit, it will retain this character regardless of the purpose of its mission or the activities in which it engages. Not until it makes its re-entry into the earth's atmosphere would there be any question as to its legal definition.

Disabling A Non-Owned Space Object

The shuttle, because of its versatility in orbit, is capable of rendezvous with other space objects be they owned by the state of registry or by any other state. Therefore, it is possible that the shuttle, by reason of its powers of investigation in orbital flight, could conceivably cause unintentional or intentional damage, or cause interference to another space object not of the state of registry of the shuttle orbiter. In this event, the provisions of Article IX and Article VII of the Outer Space Treaty[14] would govern the responsibility owed by the state of the shuttle's registry to the state of registry of the space object; and depending upon the degree of negligence, if any, or deliberate action of the shuttle crew, liability for any damage caused may be charged against the state of registry of the shuttle under Article III of the Draft Liability Treaty.[15]

Removing From Orbit Non-Owned Space Objects

Since the shuttle has a transport compartment capable of storing large cargoes, it is possible that a state may undertake to remove a space object, carried upon the registry of another state, from orbit and return the same to the surface of the earth. Although it would not be contemplated that such would occur without the consent of the state of

[13]Draft Convention on International Liability for Damage Caused by Space Objects, supra note 8, at 20.

[14]Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies. U.N. Doc. A/Res/222 (XXI), December 19, 1966, T.I.A.S. No. 6347.

[15]Supra note 8, at 20.

registry, there may be occasion to remove a non-owned object from orbit if the same is causing undue or unreasonable interference or if the same may be a hazard to persons and property of the state of registry of the shuttle. It would be anticipated that any such action would be carried out only after having provided the state of registry of the space object with notice under Article IX of the Outer Space Treaty,[16] and after consultation has been had or denied as contemplated in the Article.

There could be situations in which the nature of the potential danger is so great that the removal is considered an act of self-defense. For example, this would be true if the same object carried a nuclear weapon or weapon of mass destruction in violation of Article IV of the Treaty.[17]

Strategic Observations

The shuttle craft, as contemplated, is capable of being used as an observation platform for investigation of earth resources which include mapping, photographing and similar types of investigation. In conducting this activity, it is also quite possible that the personnel of the shuttle may engage in other observations of a strategic nature that could affect military security of the state being observed. Should the shuttle be used for such observations, the question may arise as to whether or not under the principle set forth in Article III the Treaty is being violated.[18] Since many military satellites are now in orbit, and are conducting reconnaisance activities, it is doubtful that any serious objection would be raised to this type of outer space investigation, so long as it is conducted in the interest of self-defense, and so long as it does not create a threat against the peace and political integrity of the state being observed.[19]

International Control

The question of international control relates not only to the shuttle craft, but also to any objects orbiting earth, either in near earth or in stationary orbit. At this time, activities in earth orbit outer space are governed in principle by the Outer Space Treaty

16"A State Party to the Treaty which has reason to believe that an activity would cause potentially harmful interference with activities in the peaceful exploration and use of outer space may request consultation concerning the activity or experiment."

17"States parties to the Treaty undertake not to place in orbit around the earth any objects carrying nuclear weapons or any other kinds of weapons of mass destruction or station such weapons in outer space in any other manner."

18"States Parties to the Treaty shall carry on activities in accordance with international law, including the Charter of the United Nations, in the interest of maintaining international peace and security and promoting international cooperation and understanding."

19For a comprehensive discussion of reconnaisance activities in outer space see *Morenoff, World Peace Through Space Law* (1967), and Soraghan, Reconnaissance Satellites: Legal Characterization and Possible Utilization for Peace Keeping, 67 *McGill L. J.* 458-493 (1967).

and the Astronaut Rescue Treaty.[20] If the draft convention on liability is ratified by the requisite number of states, this treaty will also apply to earth orbit activities. As yet, however, there is no centralized control nor is there a single document which would govern the action of states in the conduct of activities in outer space on the order of the International Civil Aviation Organization, as created by the Chicago Convention. It is the thesis of this author that in due time an outer space agency will be established to provide for a coordination of effort and activity in outer space within a single international organization. It would be given the function of establishing coordination between existing agencies, adoption of rules and regulations relating to outer space flight, and providing for a procedure for settlement of claims and disputes within a juridicial organ adjunctive to the main agency.[21]

For the time being, however, international control of the shuttle vehicle is not anticipated. Since the activities of the shuttle will not take place until the latter part of this decade, some progress may have been made toward the establishment of an international agency.

As proposed by this writer, the organizational structure contemplated is set forth in a chart which diagrams the procedural aspects of the functional responsibility of the agency.[22] It should be noted that included in the structure are provisions for establishing space rescue and space contamination sections. The shuttle system would be particularly adaptable to these functions and it may well be that an international agency would own or have control of one or more shuttle vehicles to perform one or more purposes within its area of responsibility; for example, rescue or investigation of the peaceful pursuit of manned and unmanned orbiting satellites and laboratories. Observation by an international inspection team may eliminate the need for unannounced visitations by personnel of other states.[23]

THE SHUTTLE AS AN AIRCRAFT

When the shuttle has performed its mission and purpose in near earth orbit, it must begin its descent and enter the atmosphere for landing at a designated site. During this phase of the flight, the shuttle will be capable of a degree of aero-dynamic flight and may maneuver in the airspace for some period of time. In this configuration, it is questionable as to what type of vehicle the orbiter actually is. For all practical purposes, it will function as an aircraft in the airspace, and logically, it should be subject to the national

[20]Agreement on Rescue of Astronauts, The Return of Astronauts, and the Return of Objects Launched into Outer Space, U.N. Doc., A/Res/2345 (XXII), January 16, 1968.

[21]See Tamm, supra note 12.

[22]Ibid.

[23]Articles X and XII of the Outer Space Treaty provide for visitation after consultation and upon the basis of reciprocity; however, it is not clear if these provisions include space objects and stations in earth orbit.

laws and regulations of the territory in which it is engaged in flight; and if in international territory, then it is reasonable to assume that it would be subject to the recommended rules and practices of the International Civil Aviation Organization.

For purposes of responsibility, it may be argued that existing rules of liability as presently applied to aircraft would also be applicable to the orbiter in this stage of its flight program. Applying the principle of dual definition, one would question the applicability of the Draft Convention on International Liability for Damage as set forth in Article II, if, in fact, there was damage resulting to the surface of the earth or to other aircraft in flight. The problem would not arise if the injury occurred over the territory of the state of registry and the state of launch, but should the incident occur in international airspace or over the territory of a third state, then, in that event, the issue of definition of "space object" or "aircraft" would be quite material. It would seem to this writer, that if, in fact, the orbiter is fully capable of sustained flight by aero-dynamic lift, and it is functioning in that configuration at the time the collision occurs or damage on the surface of the earth results, that the rules relating to aircraft operation would pertain, rather than the rules of the draft convention.

National Control

Taking into account that the orbiter when functioning in the airspace is also an aircraft as well as a space object, the national rules relating to flight in the airspace would be fully applicable to the orbiter's flight. Most landings would occur in the state of registry of the shuttle and, therefore, any necessary modification to national rules to conform to the orbiter's flight characteristics could be easily amended. However, should the orbiter engage in flight in the airspace of the territory of a state not of registry, then it would appear that all rules and regulations relating to flight in the airspace would appertain to the orbiter vehicle to the same extent that said rules and regulations would appertain to other aircraft operating in that state's airspace. In view of the fact that the shuttle orbiter initially may be defined as a state aircraft as opposed to commercial aircraft as set forth under the Chicago Convention,[24] certain special procedures would have to be implemented in order to properly authorize flight in the airspace of the non-registry state. It would be assumed that such authorization had been previously coordinated, except in the event of emergency, in which case the provisions of the Astronaut Rescue Agreement would apply even though the orbiter by definition would be an aircraft.

CONCLUSIONS

From the brief considerations set forth above, one can see that the extent of activities in near earth orbit will increase and the scope of operation will materially

[24]Article 3, Convention on International Civil Aviation, 61 Stat. 1180.

change from present activities. The shuttle orbiter will provide the capability for observation of activities relating to scientific investigation of the earth, and it will provide the means of transport of personnel to scientific laboratories engaged in earth resources investigations in near outer space orbit. It will also provide a means to remove from orbit spent space objects which no longer serve a useful purpose or which may be contaminating or interfering with the activities of other objects in orbit. Additionally, the shuttle is a means to provide service and repair to unmanned observational satellites, as well as to make investigations of activities of objectionable objects and to provide rescue for personnel stranded in earth orbit.

In short, the development of outer space activity is rapidly approaching the productive stage. Such development is leading to a time when manned platforms will produce the tangible benefits that will result from the expenditures previously made in the investigation of the near earth space. The space shuttle as an observation platform and as a transport vehicle provides the bridge to expansion of the investigations of earth resources.